

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To:
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Date of mailing
(day/month/year)

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Applicant's or agent's file reference

AGTZ 2 99968PCT

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US04/40760

International filing date (day/month/year)

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05 December 2003 (05.12.2003)

International Patent Classification (IPC) or both national classification and IPC

IPC(7): F04D 3/02 and US Cl.: 415/72, 74, 143; 416/176, 177, 183, 234

Applicant

ARGO-TECH CORPORATION

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ US

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

including casing 1. The pump is a submersible pump.

Claims 5-6 lack an inventive step under PCT Article 33(3) as being obvious over the publication "An Experimental Study of Cavitation in A Mixed Flow Impeller" in view of Kato 5,947,684. Figure 1, impellers A and B, and figure 2 of the publication "An Experimental Study of Cavitation in A Mixed Flow Impeller" disclose a high performance inducer as set forth above, but do not disclose that the first portion of the hub includes a generally rounded end and a sidewall extending both radially outward and axially from the rounded end, with the sidewall having a general curvilinear conformation.

Kato 5,947,684 (figure 2) shows an inducer 12 having a first portion of a hub includes a generally rounded end 19 and an unnumbered sidewall extending both radially outward and axially from the rounded end, with the sidewall having a general curvilinear conformation, for the purpose of smoothly guiding flow to the inducer.

It would have been obvious to a routineer in the art to form the impellers A and B of the publication "An Experimental Study of Cavitation in A Mixed Flow Impeller" such that the first portion of the hub includes a generally rounded end and a sidewall extending both radially outward and axially from the rounded end, with the sidewall having a general curvilinear conformation, as taught by Kato 5,947,684.

Claim 13 lacks an inventive step under PCT Article 33(3) as being obvious over the publication "An Experimental Study of Cavitation in A Mixed Flow Impeller" in view of Rylewski 3,522,997. Figure 1, impellers A and B, and figure 2 of the publication "An Experimental Study of Cavitation in A Mixed Flow Impeller" disclose a high performance inducer as set forth above, but do not disclose that the primary blades and secondary blades have a thickness that tapers from a leading edge of the primary and second blades to a substantially constant thickness over the remaining circumferential extent of the primary and secondary blades.

Rylewski 3,522,997 (figures 2-3 and column 4, lines 42-47) shows an inducer 10 having blades 13, 13' that have a thickness that tapers from a leading edge of the blades to a substantially constant thickness over the remaining circumferential extent of the blades, for the purpose of providing constant flow over the blades.

It would have been obvious to a routineer in the art to form the impellers A and B of the publication "An Experimental Study of Cavitation in A Mixed Flow Impeller" such that the primary blades and secondary blades have a thickness that tapers from a leading edge of the primary and second blades to a substantially constant thickness over the remaining circumferential extent of the primary and secondary blades, as taught by Rylewski 3,522,997.

Claim 17 lacks an inventive step under PCT Article 33(3) as being obvious over Coats 1,874,450 in view of Rylewski 3,522,997. Coats discloses a high performance inducer as set forth above, but does not disclose that the primary blades and secondary blades have a thickness that tapers from a leading edge of the primary and second blades to a substantially constant thickness over the remaining circumferential extent of the primary and secondary blades.

Rylewski 3,522,997 (figures 2-3 and column 4, lines 42-47) shows an inducer 10 having blades 13, 13' that have a thickness that tapers from a leading edge of the blades to a substantially constant thickness over the remaining circumferential extent of the blades, for the purpose of providing constant flow over the blades.

It would have been obvious to a routineer in the art to form the impeller of Coats such that the primary blades and secondary blades have a thickness that tapers from a leading edge of the primary and second blades to a substantially constant thickness over the remaining circumferential extent of the primary and secondary blades, as taught by Rylewski 3,522,997.

Claim 20 lacks an inventive step under PCT Article 33(3) as being obvious over Coats 1,874,450. Coats discloses a high performance inducer as set forth above, but does not disclose that the vapor to liquid ratio of the pumped fluid is up to about a 1:1 ratio.

It would have been obvious to a routineer to form the inducer of Coats such that the vapor to liquid ratio of the pumped fluid is up to about a 1:1 ratio, because adjusting the inducer blade and hub configuration to obtain a specific vapor to liquid ratio and inducer performance is known to routineers in the art.

Claims 1-20 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the claimed subject matter can be made or used in industry.

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PCT/US04/40760

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This opinion has been established on the basis of a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

☐ a sequence listing

☐ table(s) related to the sequence listing

b. format of material

☐ in written format

☐ in computer readable form

c. time of filing/furnishing

☐ contained in international application as filed.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

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Box No. V Reasoned statement under Rule 43 bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)

Claims 5-6, 10, 12-13, 17, 20 YES

Claims 1-4, 7, 9, 11, 14-16, 18-19 NO

Inventive step (IS)

Claims NONE YES

Claims 1-7, 9-20 NO

Industrial applicability (IA)

Claims 1-7, 9-20 YES

Claims NONE NO

2. Citations and explanations:

Please See Continuation Sheet

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PCT/US04/40760

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

The drawings are objected to under PCT Rule 66.2(a)(iii) as containing the following defect(s) in the form or content thereof: the drawings do not contain any of the reference numerals listed in paragraphs 25-29 of the specification, and are missing reference numerals "150b" and "150c".

The claims are objected to under PCT Rule 66.2(a)(iii) as containing the following defect(s) in the form or contents thereof:

Claim 8 is missing.

The description is objected to as containing the following defect(s) under PCT Rule 66.2(a)(iii) in the form or contents thereof:

In paragraph 30, line 1, "showings" should be changed to -- drawings --.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

V. 2. Citations and Explanations:

Claims 1-4, 7, 9, and 11 lack novelty under PCT Article 33(2) as being anticipated by the publication "An Experimental Study of Cavitation in A Mixed Flow Impeller" (figure 1, impellers A and B, and figure 2). Note the inducer for pumping cryogenic two phase fluids from reservoirs, comprising a hub with a first portion having a first diameter and a second portion having a second diameter larger than the first diameter, plural primary blades circumferentially disposed about the hub, plural secondary blades circumferentially disposed about the hub, with each secondary blade being interposed between two primary blades, the hub increasing in diameter from the first portion to the second portion, a radial depth of the plural primary and secondary blades being substantially greater at the first portion of the hub than at the second portion of the hub, an outer diameter of each primary blade and each secondary blade being generally constant from a leading edge to a trailing edge of the primary and secondary blades, the blades having a generally helical conformation, the primary blades extending circumferentially about the hub generally 180 degrees from a leading edge to a trailing edge thereof, with a leading edge of each secondary blade being circumferentially spaced generally 60 degrees from a leading edge of an adjacent primary blade (see in particular impeller A).

Claims 1-2 lack novelty under PCT Article 33(2) as being anticipated by Kun 4,904,158. Note the inducer for pumping cryogenic two phase fluids from reservoirs, comprising a hub near 8 with a first portion near 6 having a first diameter and a second portion near 5 having a second diameter larger than the first diameter, plural primary blades 4 circumferentially disposed about the hub, plural unnumbered secondary blades circumferentially disposed about the hub, with each secondary blade being interposed between two primary blades, the hub increasing in diameter from the first portion to the second portion.

Claims 1-3 and 7 lack novelty under PCT Article 33(2) as being anticipated by Meng 6,435,829 (figures 1 and 7). Note the inducer for pumping cryogenic two phase fluids from reservoirs, comprising a hub 12 with a first front portion having a first diameter and a second rear portion having a second diameter larger than the first diameter, plural primary blades 14 circumferentially disposed about the hub, plural secondary blades 14 circumferentially disposed about the hub, with each secondary blade being interposed between two primary blades, the hub increasing in diameter from the first portion to the second portion, a radial depth of the plural primary and secondary blades being substantially greater at the first portion of the hub than at the second portion of the hub, and the primary blades having a generally helical conformation.

Claims 1-4, 7, 11, 14-16, and 18-19 lack novelty under PCT Article 33(2) as being anticipated by Coats 1,874,450 (figures 1-2). Note the inducer for pumping cryogenic two phase fluids from reservoirs, comprising a hub 6 with a first portion having a first diameter and a second portion having a second diameter larger than the first diameter, plural primary blades 5 circumferentially disposed about the hub, plural secondary blades 5 circumferentially disposed about the hub, with each secondary blade being interposed between two primary blades, the hub increasing in diameter from the first portion to the second portion, a radial depth of the plural primary and secondary blades being substantially greater at the first portion of the hub than at the second portion of the hub, an outer diameter of each primary blade and each secondary blade being generally constant from a leading edge to a trailing edge of the primary and secondary blades, the blades having a generally helical conformation, a leading edge of each secondary blade being circumferentially spaced generally 60 degrees from a leading edge of an adjacent primary blade. The inducer is part of a downhole pump assembly